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Is Socially Responsible Investing Really Beneficial? New Empirical Evidence for the US and European Stock Markets

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Abstract

This paper empirically examines the theoretically ambivalent relationship between socially responsible investing (SRI) and stock performance. It extends the existing literature by considering both the US and the entire European stock markets as well as by using consistent world-wide corporate sustainability performance data. Our portfolio analysis from 1998 to 2009 reveals the appeal of a recently constructed financial databank comprising the common market return, size, value, and momentum factors according to Carhart (1997). These risk factors from the four-factor model allow us to estimate more reliable risk-adjusted returns than in the restrictive one-factor model based on the Capital Asset Pricing Model. In both the US and European stock markets we find that SRI is associated with large-sized firms. However, this investment strategy generally leads to insignificant abnormal returns when all four risk factors are considered so that we find no evidence that SRI is either penalized or rewarded by the stock markets.

Keywords:
Socially responsible investing, Corporate sustainability performance, Stock performance, Portfolio analysis, Asset pricing models, Risk factors

JEL:
G11, G12, Q56, M14

1. Introduction

Growing individual awareness of environmental, social, and ethical issues is strongly affecting purchase decisions of customers, for example, with respect to certified organic or fair-trade foods. This development is fuelling private and institutional investment decisions towards socially responsible investing (SRI), also labeled ethical or sustainable investing (e.g. Renneboog et al., 2008). This investment strategy consists of choosing stocks on the basis of environmental, social, and ethical screens (e.g. Barnett and Salomon, 2006). SRI has experienced strong growth around the world. According to Eurosif (2010), the share of European SRI assets has almost doubled from 2007 to 2009. The Sustainable Investment Forum for Germany, Austria, and Switzerland estimates that SRI assets have increased by 20% in the year 2010 and hit 94.5 bn Euro in these countries (Forum Nachhaltige Geldanlagen, 2011). For the US, the Forum for Sustainable and Responsible Investment reports that one out of eight invested US dollars (USD) follows SRI guidelines (US Sif, 2010). This corresponds to an increase of 182% from 2007 to 2010 in total net assets.

This development in SRI has highly attracted academic interest so that several empirical studies examine whether environmental, social, or ethical investments are penalized or rewarded by the stock markets. Methodologically, these studies use common micro-econometric approaches (e.g. Filbeck and Gorman, 2004, Ziegler et al., 2007a), the short-term event study approach (e.g. Teoh et al., 1999, Cañón-de-Francia and Garcés-Ayerbe, 2009, Capelle-Blancard and Laguna, 2010, Fisher-Vanden and Thorburn, 2011, Oberndorfer et al., 2011), or portfolio analyses. Most studies in this field are based on the third approach by directly considering the investor perspective, comparing the stock performance of SRI funds and portfolios with the stock performance of conventional funds and portfolios.

One direction of such portfolio analyses examines the performance of sustainability stock indexes (e.g. Sauer, 1997, Bauer et al., 2005, Schröder, 2007), such as the Domini 400 Social Index. These stock indexes like the Dow Jones Sustainability Index family (see also the empirical studies of

Ziegler and Schröder, 2010, Ziegler, 2012) constitute the basis for some socially responsible mutual funds. A second group of portfolio analyses compares the risk-adjusted stock returns of socially responsible funds with the corresponding risk-adjusted stock returns of conventional mutual funds (e.g. Bauer et al., 2005, 2007). However, studies on actively managed mutual funds have the drawback that the SRI impact on financial performance cannot be disentangled from the effects of the ability of asset managers. This problem is addressed by a third group of portfolio analyses, building on synthetic portfolios based on corporate sustainability performance assessments, for example, provided by Innovest (e.g. Derwall et al., 2005) or KLD Research & Analytics (e.g. Kempf and Osthoff, 2007). Some of these assessments are the basis for popular sustainability stock indexes, such as the Domini 400 Social Index that is constructed with KLD ratings.

Theoretically, the stock performance effect of SRI is ambivalent. The following three hypotheses are discussed (e.g. Hamilton et al., 1993, Bauer et al. 2005): First, if SRI increases the value of socially responsible firms by decreasing the expected returns and the cost of capital of these firms, SRI portfolios deliver lower stock returns than conventional portfolios. The second hypothesis is that the stock returns of SRI portfolios are higher than those of their conventional counterparts if SRI characteristics are not correctly priced by stock markets. Finally, the third hypothesis is that SRI is neither penalized nor rewarded by stock markets if corporate sustainability performance or corporate social responsibility (CSR), referring to corresponding corporate environmental, social, and ethical activities, is not priced. This argument represents the common finance view with SRI not influencing the cost of capital of socially responsible firms. Against this background, the question whether SRI leads to higher or lower stock returns can only be examined empirically.

Our portfolio analysis is in line with the aforementioned third direction of studies, i.e. we use raw corporate sustainability performance assessments. The main contribution of this study to the corresponding empirical literature is two-fold: First, in contrast to most former studies, we do not only consider the US stock market, but also analyze the entire European stock market based on consistent

world-wide corporate sustainability performance data from the Swiss bank ZKB (Zurich Cantonal Bank). This allows a comparative analysis for these two world-wide leading stock markets. Second, our portfolio analysis reveals the appeal of a new financial databank that has recently been constructed at the University of Zurich and ETH Zurich (Schmidt et al., 2011), comprising the common market return, size, value, and momentum factors according to Carhart (1997). These risk factors from the four-factor model are necessary to estimate risk-adjusted returns that are more reliable than corresponding return estimates in a restrictive one-factor model based on the Capital Asset Pricing Model (CAPM). The risk factors from this flexible multifactor model are publicly available for the US and some other stock markets and have already been applied in former SRI portfolio analyses. However, only our new and elaborate (Pan-)European size, value, and momentum factors allow an analysis for the entire European stock market.

Our portfolio analysis has two dimensions: In a first step, we only examine firms that are included in the Morgan Stanley Capital International (MSCI) World Index. Based on the corporate sustainability performance assessments by ZKB, we construct US and European portfolios comprising firms that are sector leaders in terms of sustainability performance and corresponding portfolios comprising firms that are not sector leaders. These stock portfolios are then used to estimate average monthly risk-adjusted or abnormal returns. Furthermore, we consider a trading strategy of buying stocks of MSCI firms that are sector leaders in terms of sustainability performance and selling stocks of MSCI firms that are not sector leaders. In a second step, we additionally include firms from the US and European stock markets that are not part of the MSCI, but are identified as leaders in terms of sustainability performance by ZKB. We estimate again average monthly risk-adjusted returns for the corresponding slightly more diversified portfolios.

The remainder of the paper is structured as follows: In the second section, we present our portfolio analysis approach. The third section refers to a discussion of the data, particularly the new financial data. The fourth section discusses the empirical results and the final section concludes.

2. Methodological Approach

In order to examine whether SRI is penalized or rewarded by the stock markets, our portfolio analysis compares the average stock performance of portfolios comprising firms that differ with respect to their sustainability performance. In line with recent studies (e.g. Derwall et al., 2005, Bauer et al., 2005, 2007, Kempf and Osthoff, 2007, Ziegler et al., 2011) we consider the risk-adjusted returns of different stock portfolios that are estimated on the basis of asset pricing models. So far, the traditional and most fundamental asset pricing model is the one-factor model based on the market model (e.g. Sharpe, 1963) and the CAPM (e.g. Lintner, 1965, Fama and French, 2004, Perold, 2004). This model can be formulated for a portfolio i in month t (i = 1,…,N; t = 1,…,T) as:

$$r_{it} - r_{ft} = \alpha_i + \beta_i (r_{mt} - r_{ft}) + \varepsilon_{it}$$

In this approach r_{it} and r_{mt} are the (continuous) stock returns of portfolio i and the market at the end of month t, r_{ft} is the risk-free interest rate at the beginning of month t, and ε_{it} is the disturbance term with $E(\varepsilon_{it}) = 0$ and (unknown) $var(\varepsilon_{it}) = \sigma_\varepsilon^2$. The one-factor alpha α_i (i.e. Jensen's alpha) and β_i are further unknown parameters, which are estimated by ordinary least squares (OLS). This model assumes that β_i captures the non-diversifiable risk of each stock portfolio in the explanation of the excess returns r_{it}-r_{ft}.

Based on the "anomalies" discussion questioning the validity of the CAPM (e.g. Banz, 1981, DeBondt and Thaler, 1985, Fama and French, 1992), Fama and French (1993) have developed a three-factor model, which includes – in addition to the excess returns r_{mt}-r_{ft} of the stock market – two factors with respect to size and value to explain the excess portfolio returns r_{it}-r_{ft}. Many empirical studies show that this three-factor model has more explanatory power than the one-factor model based on the CAPM, for example, Fama and French (1993, 1996) for the US, Berkowitz and Qiu (2001) for the Canadian, Hussain et al. (2002) for the British, and Schrimpf et al. (2007) or Ziegler et al. (2007b) for the German stock market. With the emergence of this three-factor model the dis-

cussion about an additional factor, namely the momentum factor, began (e.g. Jegadeesh and Titman, 1993, 2011, Rouwenhorst, 1998) and resulted in the following four-factor model of Carhart (1997), which is currently the most common asset pricing model for general applications in financial economics (e.g. L'Her et al., 2004, Bollen and Busse, 2005) including SRI portfolio analyses:

$$r_{it} - r_{ft} = \alpha_i + \beta_{i1} (r_{mt} - r_{ft}) + \beta_{i2} SMB_t + \beta_{i3} HML_t + \beta_{i4} WML_t + \varepsilon_{it}$$

In this model the Fama-French size factor SMB_t is the difference between the returns of portfolios comprising stocks of "small" firms and portfolios comprising stocks of "big" firms at the end of month t. The Fama-French value factor HML_t is the difference between the returns of portfolios comprising stocks of firms with a "high" book-to-market equity ratio and portfolios comprising stocks of firms with a "low" book-to-market equity ratio at the end of month t. Finally, the Carhart momentum factor WML_t is the difference between the returns of portfolios comprising stocks of recent "winners" and portfolios comprising stocks of recent "losers" at the end of month t. The unknown parameters are now the four-factor alpha α_i as well as β_{i1}, β_{i2}, β_{i3}, and β_{i4} in addition to $var(\varepsilon_{it}) = \sigma_\varepsilon^2$ and are again estimated by OLS.

The parameter of principal interest is α_i and is interpreted as the average monthly risk-adjusted or abnormal return of stock portfolio i not explained by the single risk factor in the one-factor model based on the CAPM or by the four risk factors in the Carhart multifactor model. In the following, the alphas thus measure the stock return out- or underperformance of portfolios comprising firms that are or are not sector leaders in terms of sustainability performance compared with the stock market. Furthermore, we consider for the group of MSCI firms a trading strategy of buying stocks of firms that are sector leaders and selling stocks of firms that are not sector leaders in terms of sustainability performance. For this long-short strategy we examine returns of stock portfolios that are calculated by the difference between the returns of portfolios. The corresponding alphas can be calculated by the difference between the two separated one- or four-factor model alphas.

3. Data

3.1 Corporate Sustainability Performance Data

In our study we use corporate sustainability performance data from ZKB, the biggest cantonal bank in Switzerland and one of the leading suppliers of SRI products on the Swiss financial market. ZKB employs a team of analysts with the mandate to identify firms that can be considered as sustainability leaders. Compared with other suppliers of SRI products, the screening process of ZKB is rigorous since a positive screening is preceded by a broad negative screening process. Firm preclusion criteria of the negative screening process comprise main business operations centered around: Production of fossil energies, operation of energy plants based on fossil energies or nuclear energy, production of cars or planes, airlines, production of ozone depleting substances, production of harmful substances according to the Stockholm agreement, not sustainable fishery or forestry, production of nuclear reactors, operations related to genetically modified organisms, production of weapons or military machines, as well as production of tobacco and cigarettes.

During the assessment process the analyst team of ZKB consults firm documents such as annual reports and CSR reports as well as various environmental and social governance databases. The negative screening is followed by a consultation of important media to ensure that the firms are not involved in any problematic controversies and a best-in-class approach. The resulting assessment from this annual process is dichotomous and identifies firms leading their sector in terms of sustainability performance. Such firms are not said to have no improvement potential, but have a more in-depth approach to environmental, social, and corporate governance issues than their competitors. It should be noted that ZKB – in line with other suppliers of SRI products – focuses on firms with higher market values (including all MSCI firms) compared with the entire stock market universes. This size difference has to be considered when the results of our portfolio analysis are interpreted. An analysis with a rather small group of small- to medium-sized firms based on an alternative assessment concept of ZKB can be found in Mollet et al. (2012).

Based on these corporate sustainability performance assessments, we consider three portfolios on the US and European stock markets. The portfolio 'sustainability leaders' comprises in each year firms that are general sector leaders in terms of sustainability performance. The portfolio 'MSCI sustainability leaders' comprises in each year the group of sustainability leaders among all MSCI firms over time, and the portfolio 'other MSCI firms' comprises in each year the group of MSCI firms that are not sustainability leaders. The portfolio 'MSCI sustainability leaders' is thus a sub-group of the portfolio 'sustainability leaders' since the latter comprises both the sector leaders in terms of sustainability performance among all firms in the MSCI as well as some sustainability leaders that are not part of the MSCI. Additionally, we also analyze long-short portfolios on the basis of a trading strategy of buying stocks of sustainability leaders in the MSCI and selling stocks of the other firms in the MSCI that are not sector leaders in terms of sustainability performance.

3.2 Financial Data: A New Databank

Our financial data stem from a new databank that has recently been constructed at the University of Zurich and ETH Zurich (for details of the following discussion, see Schmidt et al., 2011). In line with Ince and Porter (2006), the starting point of the construction of the databank, particularly including the market return, SMB, HML, and WML factors according to Carhart (1997), is the Thomson Reuters Datastream constituent lists. Besides research lists, we also use "dead lists", Thomson Reuters Worldscope lists, and for some countries specific lists provided by Thomson Reuters Datastream and Thomson Reuters Worldscope. We use the "dead lists" of firms that cease to exist – due to mergers, bankruptcy or other reasons – to control for survivorship bias and Thomson Reuters Worldscope lists and additional lists to get a population as large as possible. On the basis of this initial sample, we first sort out firms that are obviously not part of our target population. To do this we use firm characteristics, which are assumed to be constant over time, i.e. static screens. Reasons why firms are excluded by the static screens are that they are not major listings (e.g. preferred shares), they are foreign stocks, they are additional listings (e.g. closed-end-funds), or that there are

no data available. After the static screens, we extract time series data for these firms. The time series draws have a yearly frequency for Thomson Reuters Worldscope data and a monthly frequency for Thomson Reuters Datastream data. To allocate the yearly data to the monthly data we rely on the fiscal year end information as provided by Thomson Reuters Worldscope.

In order to correct the monthly data, we apply dynamic screens as suggested by Ince and Porter (2006) as well as additional filters. Overall, for the whole time series we use 13343 US firms and 11054 European firms to construct the stock market return factor, 11114 US firms and 9462 European firms to construct the SMB and HML factors, as well as 11654 US firms and 10035 European firms to construct the WML factor. Some further issues cannot be fixed by the suggestions of Ince and Porter (2006). Most important, the exchange affiliation is only recorded for the current point in time. We choose to use all firms that are available on Thomson Reuters Datastream and Thomson Reuters Worldscope, which means that there are not only NYSE, AMEX, or NASDAQ firms for the US stock market. This implies that our US sample is drawn from a different population compared with the population described by Fama and French (1993). However, the alternative of using only firms listed on the NYSE, AMEX, or NASDAQ at the end of the sample period would result in a sample suffering from survivorship bias.

There are two additional issues for the European stock market that are not relevant or of minor relevance for the US stock market. First, the adoption of the Euro in January 2002 implies that there are two currencies in all countries that switched to the Euro. Data of firms that are traded after January 2002 are dominated in Euros, whereas data of firms that are delisted before January 2002 are denominated in the old currency of the respective country. This can easily be fixed by using the fixed Euro conversion rate and expressing all cash values (like size) in Euro values. Second, for some European countries dividend data are obviously erroneous. For some firms, the dividends are of a magnitude of about ten times the actual price series, which means that some screening procedures result in unusually high stock returns of several hundred % whenever dividend payments are dis-

tributed. A casual inspection shows that sometimes dividend payments made later are a fraction of the unusually high dividends, which leads us to the conjecture that a decimal or other error was responsible for these implausible values. We correct this issue by applying the following procedure: Whenever a dividend payment is higher than 50% of the adjusted price, we divide the Thomson Reuters Datastream dividend by a certain value. We apply this screen also for the US stock market, although this issue is not of practical relevance there.

The stock return calculation is based on closing prices of the last trading day of each month. If a stock of a firm is not traded on the last trading day, the last valid trading price is used. The Thomson Reuters Datastream total return indexes that we use for return calculation include dividends and account for stock splits. We calculate book equity as Thomson Reuters Worldscope common equity plus deferred taxes, if available. For all sorts we use only stocks of firms with available positive book equity. Size is either the Thomson Reuters Datastream market value or the product of the Thomson Reuters Datastream unadjusted price with the Thomson Reuters Datastream number of shares. The book-to-market equity ratio for the sorting month June is calculated as book equity divided by size of the preceding December. We sort all stocks in June of each year. To be included in the June sort of year τ, a firm must have a positive book value and size available in December of the previous year τ-1. Furthermore, to calculate value weighted stock returns, a firm is required to have information for size from the preceding month, a valid stock return, positive book value, as well as price and number of shares.

In order to construct the SMB and HML factors for the US and European stock markets, all remaining stocks are sorted each December into three book-to-market equity ratio groups. Furthermore, we sort these stocks each June into two size groups. From the intersection of the two size groups “small” (S) and “big” (B), and the three book-to-market equity ratio groups “low” (L), “medium” (M), and “high” (H), we form six portfolios, which are held for one year. The six portfolios contain stocks of firms with small size and low book-to-market equity ratio (S/L), with small size and me-

dium book-to-market equity ratio (S/M), with small size and high book-to-market equity ratio (S/H), with big size and low book-to-market equity ratio (B/L), with big size and medium book-to-market equity ratio (B/M), as well as with big size and high book-to-market equity ratio (B/H). From the monthly value weighted returns of these six portfolios we construct the SMB and HML factors for month t as follows:

$$SMB_t = \frac{r_t^{S/L} + r_t^{S/M} + r_t^{S/H}}{3} - \frac{r_t^{B/L} + r_t^{B/M} + r_t^{B/H}}{3}$$

$$HML_t = \frac{r_t^{S/H} + r_t^{B/H}}{2} - \frac{r_t^{S/L} + r_t^{B/L}}{2}$$

$r_t^{X/Y}$ denotes the returns of a stock portfolio belonging to size class X (S or B) and book-to-market equity ratio class Y (H, M, or L) in month t based on the portfolio formation in last June.

In order to construct the WML factor, we first define our momentum measure. For each portfolio formation month t-1 we calculate for each stock the mean return from month t-12 to month t-2 and use this mean return to compile three momentum groups. This sorting takes place every month. We also construct two size groups each month. To be included in the sort, the stock return has to be available in every month from t-12 to t-2 and size must be available in month t-1. From the intersection of the two size groups S and B and the three momentum groups “losers” (L), “medium” (M), and “winners” (W), we form six portfolios. The six portfolios contain stocks of firms with small size and loser momentum (S/L), with small size and medium momentum (S/M), with small size and winner momentum (S/W), with big size and loser momentum (B/L), with big size and medium momentum (B/M), as well as with big size and winner momentum (B/W). We construct the WML factor for month t as the difference between the mean returns of the two winner portfolios and the mean returns of the two losers portfolios:

$$WML_t = \frac{r_t^{S/W} + r_t^{B/W}}{2} - \frac{r_t^{S/L} + r_t^{B/L}}{2}$$

$r_t^{X/Z}$ denotes the returns of a stock portfolio belonging to size class X (S or B) and momentum class Z (W, M, or L) in month t based on the portfolio formation in month t-1.

In each of the above sorts, we need to choose breakpoints to divide portfolios. This issue is most relevant for the size breakpoints and arises to a lesser extent for the book-to-market equity ratio and momentum sorts. With respect to size on the US stock market, Fama and French (1993) calculate breakpoints from the NYSE only, but apply the breakpoints to the entire sample of NYSE, AMEX, and NASDAQ stocks. Unfortunately, it is impossible to separate the NYSE stocks in our sample from other stocks (at least not over the whole time span). Therefore, we use an approximation by using breakpoints calculated from the entire sample, but aiming to mirror the Fama and French (1993) NYSE breakpoints. By considering the number of firms in each of the six size and book-to-market equity ratio portfolios reported on Kenneth French's website, we can calculate the average of the empirical breakpoints, which separates stocks of firms with small and big size in those portfolios. The mean (median) of this breakpoint is the 0.81 (0.81) quantile for the time period from 07/1986 to 12/2008. Furthermore, the minimum of this breakpoint is the 0.77 quantile and the maximum is the 0.84 quantile, which suggests that this breakpoint is quite stable over time. Therefore, we use in our analysis the 0.80 quantile as a breakpoint for the separation of stocks of firms with small and big size. The mean (median) of the empirical Fama-French breakpoints for the book-to-market equity ratio portfolios are the 0.36 (0.36) and 0.70 (0.70) quantiles. For the separation among the three book-to-market equity ratio groups we therefore use the 0.30 and the 0.70 quantiles. We do not use mean or median empirical breakpoints since the breakpoints we actually apply are more common in similar applications and are roughly close to the mean or median empirical breakpoints.

3.3 Descriptive Statistics

The upper part of Table 1 reports the number of sample firms in the three portfolios 'sustainability leaders', 'MSCI sustainability leaders', and 'other MSCI firms' across industries according to the

Industry Classification Benchmark (ICB), separately on the US and European stock markets. The lower part of this table shows the number of sample firms across the European countries as classified by Thomson Reuters Datastream according to the home or listing country of a stock. For reasons of brevity we only report in Table 1 the cross-sectional distributions for the last year with full coverage, i.e. 2008. In this year the US portfolios comprise 591 firms and the European portfolios 575 firms. In the US most firms stem from the financial sector (110), followed by firms from the industrials industry (89). This pattern is similar for Europe with 129 industrial and 127 financial firms, although the order is narrowly reversed. With respect to the US sustainability leaders, the highest number of firms is from the technology sector. In contrast, the highest numbers of European sustainability leaders are in the industrials, financials, consumer services, and consumer goods sectors. Overall, the European stock market contains a substantially higher number of sustainability leaders than the US stock market in 2008.

Table 2 reports the numbers of sample firms and average market values from 1998 to 2009 for the three portfolios 'sustainability leaders', 'MSCI sustainability leaders', and 'other MSCI firms'. While the upper part of the table refers to the US, the lower part refers to the European stock market. The table shows that the number of European sustainability leaders is not only in 2008 but in each year higher than the number of US sustainability leaders. This result is not implying that European firms are more sustainable than US firms because this disparity could also be driven by a higher focus of ZKB on the European stock market. Table 2 also reports that the number of sustainability leaders strongly increases over time in both regions. Moreover, the table points to a further size tilt in the US: Not only the average size of the assessed firms is higher compared with the entire stock market universes, but also the average market values of sustainability leaders and particularly of MSCI sustainability leaders are in each year distinctly higher than the average market values of other MSCI firms that are not sustainability leaders. A similar but less pronounced size difference between sustainability leaders and MSCI firms that are not sustainability leaders can be observed on the European stock market. But the size differences between the three portfolios 'sustainability

leaders', 'MSCI sustainability leaders', and 'other MSCI firms' on the European stock market decrease over time, whereas they remain stable on the US stock market.

Table 3 reports average monthly returns across the full time period of our analysis from 01/1998 to 04/2009 on the US (upper part) and European (lower part) stock markets. Additionally, the table reports the returns for the three sub-periods 01/1998-08/2001, 09/2001-08/2005, and 09/2005-04/2009. While the first and last sub-periods comprise 44 months, the sub-period from 09/2001 to 08/2005 spans 48 months in order to include the 2001 terrorist attack on the world trade centre in New York and its financial markets implications. The average monthly returns (in %) are reported for the entire stock markets, the risk-free interests, the SMB, HML, and WML factors as well as for the portfolios 'sustainability leaders', 'MSCI sustainability leaders', and 'other MSCI firms'. The monthly risk-free interest rates r_{ft} for Europe is proxied by the Fibor for the year 1998 and by the Euribor from 1999 to 2009. For the US the monthly interbank offered rate is used. Since all our financial data are finally denominated in USD, the returns are also calculated on this basis.

The average monthly risk-free interest rate amounts to 0.31% (annually 3.8%) over the full time period for both regions. The average monthly return on the European stock market amounts to 0.29% and is substantially higher than the 0.08% on the US stock markets. In both regions the strongly negative returns in the last sub-period are striking. Out of the three risk factors, the WML factor delivers the highest average returns over the full time period on the US and European stock markets. Furthermore, this risk factor has positive average returns in all sub-periods. In contrast, the average returns of the SMB factor are in both regions negative in the first sub-period, substantially positive in the second sub-period and in the last sub-period negative in the US and slightly positive in Europe.

The focal point in Table 3 are the average monthly stock returns for the three portfolios. While the returns across the full time period are positive for the MSCI firms that are not sustainability leaders, the corresponding average returns for the portfolios 'sustainability leaders' and 'MSCI sustainability

leaders' are negative in both regions. In line with the average monthly returns on the stock markets, the returns for all three portfolios continuously decrease over time in the US so that they are even negative in the last sub-period. While the average returns in Europe are also negative for all three portfolios in the last sub-period, the portfolio 'other MSCI firms' has the highest positive average return in the sub-period from 09/2001 to 08/2005 in this region. However, the average monthly stock returns for the portfolio 'other MSCI firms' are in all sub-periods and in both regions more positive than the returns of the sustainability leaders. A naive interpretation of this result not taking heterogeneity into account would consider this as evidence for a negative relationship between corporate sustainability performance and stock performance. However, Table 2 already shows an important driver of heterogeneity, namely a size tilt of the sustainability leaders. By conducting a more reliable portfolio analysis as discussed in the second section, the results from the univariate descriptive statistics are scrutinized in the following.

4. Estimation Results

4.1 Aggregated Results

Table 4 reports the estimation results in one- and four-factor models across the full time period from 01/1998 to 04/2009 for the portfolios 'sustainability leaders', 'MSCI sustainability leaders', 'other MSCI firms', as well as for the long-short portfolio as discussed above. The upper part of this table refers to the US stock market, while the lower part refers to the European stock market. For each portfolio the first row reports the results in the one-factor model based on the CAPM, while the second row reports the respective results in the Carhart four-factor model. In order to control for possible distortions due to heteroskedasticity or autocorrelation in the disturbance term, only the robust heteroskedasticity- and autocorrelation-consistent z-statistics according to Newey and West (1987) are reported besides the parameter estimates. In line with common practice (e.g. Greene, 2002), we assume a possibly autocorrelated error structure up to three lags.

The estimation results point to the high practical relevance of the application of the four-factor model compared with the restrictive one-factor model and thus of our new financial databank. The results in the four-factor model reveal in both regions a significantly negative loading of the SMB factor. This finding is not surprising since the average monthly returns of the SMB factor are according to Table 3 positive on the US and European stock markets across the full time period from 01/1998 to 04/2009 (which illustrates that small-sized firms outperformed large-sized firms during this time period) and since the three portfolios comprise firms with a higher average market value than the entire stock market universes. Furthermore, the WML factor has a significantly negative loading for all three portfolios in Europe.

As a consequence, the significantly negative alphas for the portfolio 'sustainability leaders' and particularly for the long-short portfolio on the European stock market seem to be misleading since they only refer to the application of the one-factor model and become insignificant on the basis of the four-factor model. The main result of Table 4 are therefore the insignificant alphas in both regions for all portfolios in the four-factor model with the exception of a significantly positive abnormal return for the portfolio 'other MSCI firms' in the US.

4.2 Results for Different Time Periods and Sectors

However, it could be argued that these aggregated estimation results are not able to disclose possible abnormal returns in some sub-populations. In order to examine whether the estimation results differ over time (e.g. due to changing expectations or risk-premia) or between several sectors, we consider disaggregated estimations. In a first step we examine different time periods and in a second step we exclude financial firms. Table 5 and Table 6 report besides the full time period 01/1998-04/2009 the estimation results for the three sub-periods 01/1998-08/2001, 09/2001-08/2005, and 09/2005-04/2009. Due to the superiority of the Carhart four-factor model as discussed above, we omit the estimation results in the restrictive one-factor model based on the CAPM. Table 5 therefore reports

the estimation results in the four-factor model on the US, while Table 6 refers to the corresponding results on the European stock market.

Table 5 reveals that the significantly positive abnormal return across the full time period from 01/1998 to 04/2009 for the US portfolio 'other MSCI firms' is strongly affected by the alpha estimate of 0.36 in the first sub-period from 01/1998 to 08/2001. This significant abnormal return becomes insignificant in the second and third sub-periods. In line with the aggregated estimation results in Table 4, we find neither on the US stock market (see Table 5) nor on the European stock market (see Table 6) significant abnormal returns in any sub-period for the portfolios 'sustainability leaders' 'MSCI sustainability leaders', and the long-short portfolio. This time disaggregated analysis therefore confirms the main result in Table 4.

The insignificant abnormal returns are also confirmed when firms from the financial sector are excluded. The comparison between financial firms and firms from other sectors is generally of interest due to their marked differences in their valuation by the markets and their accounting rules (e.g. Ziegler et al., 2011, Ziegler, 2012), which could influence the estimation results in our portfolio analysis. In addition, financial firms were strongly affected by the stock market turbulences during the considered time period. Therefore, Table 7 (for the US stock market) and Table 8 (for the European stock market) report the corresponding estimation results in the four-factor model for the subgroup of non-financial firms and for all sub-periods besides the full time period.

Overall, the tables reveal qualitatively identical estimation results as Table 5 and Table 6. In line with Table 5, Table 7 reports for the US stock market a significantly positive abnormal return for the portfolio 'other MSCI firms' in the first sub-period from 01/1998 to 08/2001 and – as a consequence – across the full time period from 01/1998 to 04/2009. The higher magnitude of the estimated alphas for non-financial MSCI firms that are not sustainability leaders compared with all MSCI firms that are not sector leaders in terms of sustainability performance suggests that the financial firms negatively affect the significantly positive abnormal return for this portfolio. However,

the main result in Table 7 and Table 8 are again the insignificant alphas in all sub-periods for the portfolios ‘sustainability leaders’, ‘MSCI sustainability leaders’, and the long-short portfolio in the US as well as in all sub-periods and for all portfolios in Europe.

5. Conclusions

This paper empirically analyzes the theoretically ambivalent effects of SRI on stock performance on the US and the European stock markets. The basis of our identification of SRI are consistent world-wide corporate sustainability performance data from ZKB. Methodologically, we examine in our portfolio analysis the risk-adjusted returns of different stock portfolios that are estimated on the basis of asset pricing models. Our study underlines the superiority of the application of the Carhart four-factor model compared with the restrictive one-factor model based on the CAPM. We show that the estimation results in the one-factor model are misleading and that the size factor is of particular importance in the four-factor model. Our study thereby illustrates the high relevance of a recently developed financial databank, comprising – to the best of our knowledge – as a novelty the Carhart risk factors for the entire European stock market. This new databank certainly provides a rich basis for future analyses of the relationship between corporate sustainability performance and stock performance such as portfolio analyses or long-term event studies (e.g. Barber und Lyon, 1997) as well as for studies in financial economics in general.

Another main result of our paper are the generally insignificant abnormal returns for SRI on both stock markets. As a single exception, we find some positive abnormal returns for firms in the MSCI that are not sector leaders in terms of sustainability performance. But these abnormal returns arise only on the US stock market and only in the first sub-period from 01/1998 to 08/2001 becoming insignificant over time. While the general result of insignificant abnormal returns could be disappointing for the appeal of SRI, our results do not suggest that this investment strategy is penalized either on the US or on the European stock market.

With respect to the investor perspective, our portfolio analysis with corporate sustainability performance data from ZKB additionally reveals that SRI is often exposed to a size tilt. We show that not only the primarily assessed firms are on average larger than the entire stock market universes, but also that the average market values of the sustainability leaders within this population are distinctly higher than the average market values of less sustainable firms. It should be noted that the identification of sustainability leaders by ZKB within a population of firms with high market values as basis for SRI is not an exemption. For example, the assessments for the construction of the Dow Jones Sustainability Index family are similarly based on large-sized firms (e.g. Ziegler and Schröder, 2010). These assessment processes therefore strengthen the relevance of the application of multifactor models for analyses of the effects of SRI on stock performance.

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Tables

Table 1: Number of sample firms across industries and countries in 2008

Sectors						
	Portfolio 'sustainability leaders'		**Portfolio 'MSCI sustainability leaders'**		**Portfolio 'other MSCI firms'**	
	US	**Europe**	**US**	**Europe**	**US**	**Europe**
Basic Material	3	5	3	5	23	35
Consumer Good	8	17	6	15	56	49
Consumer Service	6	19	5	18	77	62
Financial	3	25	3	17	107	102
Healthcare	7	7	7	6	53	21
Industrial	3	26	2	16	86	103
Oil & Gas	1	5	1	5	45	27
Technology	10	6	10	6	56	19
Telecommunication	1	4	1	3	10	14
Utility	-	6	-	4	36	23
Overall	42	120	38	95	549	455

Country of Origin of European Firms			
	Portfolio 'sustainability leaders'	**Portfolio 'MSCI sustainability leaders'**	**Portfolio 'other MSCI firms'**
Austria	2	1	13
Belgium	3	3	18
Denmark	5	5	17
Finnland	6	5	17
France	8	7	62
Germany	14	10	36
Greece	-	-	15
Hungary	1	-	-
Ireland	1	-	10
Italy	3	1	32
Netherlands	4	4	18
Norway	3	3	17
Portugal	-	-	9
Spain	5	4	27
Sweden	11	11	30
Switzerland	20	9	26
United Kingdom	34	32	108
Overall	120	95	455

Table 2: Number of sample firms and average market value over time

US						
	Portfolio 'sustainability leaders'		**Portfolio 'MSCI sustainability leaders'**		**Portfolio 'other MSCI firms'**	
	Number of firms	**Average market value (bn USD)**	**Number of firms**	**Average market value (bn USD)**	**Number of firms**	**Average market value (bn USD)**
1998	11	46.47	8	62.57	282	23.68
1999	16	59.18	9	98.29	286	29.43
2000	24	44.70	14	68.66	289	28.72
2001	25	43.71	14	71.30	252	28.22
2002	23	32.96	17	41.33	356	19.91
2003	26	41.19	20	50.04	348	22.96
2004	35	54.19	27	67.00	400	21.23
2005	42	53.85	37	59.26	447	20.78
2006	41	53.09	36	58.56	497	21.50
2007	42	53.02	37	58.24	501	21.96
2008	42	30.71	38	32.73	549	11.53
2009	37	32.46	33	32.39	449	13.44
Europe						
	Portfolio 'sustainability leaders'		**Portfolio 'MSCI sustainabilit leaders'**		**Portfolio 'other MSCI firms'**	
	Number of firms	**Average market value (bn USD)**	**Number of firms**	**Average market value (bn USD)**	**Number of firms**	**Average market value (bn USD)**
1998	29	24.95	24	27.03	367	9.10
1999	45	20.15	24	32.49	384	11.85
2000	56	17.25	29	27.07	389	12.28
2001	62	14.81	32	24.03	387	10.06
2002	64	11.09	38	17.86	435	8.59
2003	61	14.11	40	20.47	416	11.18
2004	71	16.83	54	21.27	416	14.31
2005	105	16.62	81	20.72	424	14.06
2006	113	21.66	89	26.40	434	16.76
2007	113	24.46	93	28.34	445	19.87
2008	120	9.61	95	11.16	455	9.80
2009	124	11.42	98	13.84	441	9.12

Table 3: Average monthly returns over time (in %)

US								
	Stock market	**Risk-free interest**	**Size factor SMB**	**Value factor HML**	**Momen-tum factor WML**	**Portfolio 'sustain-ability leaders'**	**Portfolio 'MSCI sustain-ability leaders'**	**Portfolio 'other MSCI firms'**
01/1998-04/2009 (full time period)	0.08	0.31	0.21	0.23	0.62	-0.20	-0.23	0.11
01/1998-08/2001	0.56	0.45	-0.14	0.40	1.01	0.33	0.40	0.81
09/2001-08/2005	0.36	0.15	0.83	0.77	0.34	-0.05	-0.11	0.22
09/2005-04/2009	-0.71	0.33	-0.11	-0.52	0.53	-0.91	-0.99	-0.71
Europe								
	Stock market	**Risk-free interest**	**Size factor SMB**	**Value factor HML**	**Momen-tum factor WML**	**Portfolio 'sustain-ability leaders'**	**Portfolio 'MSCI sustain-ability leaders'**	**Portfolio 'other MSCI firms'**
01/1998-04/2009 (full time period)	0.29	0.31	0.19	0.48	0.99	-0.22	-0.14	0.29
01/1998-08/2001	0.38	0.30	-0.33	0.36	0.84	0.18	0.45	0.47
09/2001-08/2005	1.18	0.23	0.81	0.99	0.97	0.11	0.12	0.86
09/2005-04/2009	-0.78	0.39	0.03	0.05	1.16	-0.98	-1.00	-0.53

Table 4: Parameter estimates (z-statistics) in one- and four-factor models, full time period: 01/1998-04/2009

US						
	Alpha	**r_{mt}-r_{it}**	**SMB_t**	**HML_t**	**WML_t**	**R^2**
Portfolio 'sustainability leaders'	-0.26 (-1.18)	0.94*** (22.88)	-- (--)	-- (--)	-- (--)	0.77
	-0.16 (-0.69)	0.93*** (16.64)	-0.15* (-1.92)	-0.05 (-0.67))	-0.06 (-1.11)	0.79
Portfolio 'MSCI sustainability leaders'	-0.28 (-1.15)	0.96*** (20.98)	-- (--)	-- (--)	-- (--)	0.77
	-0.18 (-0.74)	0.96*** (16.77)	-0.18** (-2.34)	-0.02 (-0.29)	-0.05 (-0.91)	0.78
Portfolio 'other MSCI firms'	0.02 (0.33)	0.96*** (70.38)	-- (--)	-- (--)	-- (--)	0.97
	0.10** (2.01)	0.99*** (54.91)	-0.21*** (-8.81)	-0.02 (-1.48)	-0.01 (-0.57)	0.99
Long-short: MSCI firms	-0.31 (-1.22)	-- (--)	-- (--)	-- (--)	-- (--)	-0.01
	-0.28 (-1.09)	-0.03 (-0.42)	0.02 (0.29)	0.00 (0.03)	-0.05 (-0.79)	-0.02
Europe						
	Alpha	**r_{mt}-r_{it}**	**SMB_t**	**HML_t**	**WML_t**	**R^2**
Portfolio 'sustainability leaders'	-0.46* (-1.77)	0.92*** (11.08)	-- (--)	-- (--)	-- (--)	0.70
	-0.11 (-0.36)	0.81*** (9.43)	-0.52*** (-3.59)	0.01 (0.06)	-0.20** (-2.31)	0.77
Portfolio 'MSCI sustainability leaders'	-0.38 (-1.51)	0.92*** (11.49)	-- (--)	-- (--)	-- (--)	0.71
	-0.04 (-0.13)	0.81*** (9.68)	-0.50*** (-3.40)	-0.05 (-0.38)	-0.17* (-1.93)	0.77
Portfolio 'other MSCI firms'	0.02 (0.11)	0.93*** (13.82)	-- (--)	-- (--)	-- (--)	0.80
	0.23 (0.93)	0.85*** (13.14)	-0.44*** (-3.66)	0.05 (0.51)	-0.11* (-1.66)	0.84
Long-short: MSCI firms	-0.40*** (-2.72)	-0.00 (-0.14)	-- (--)	-- (--)	-- (--)	-0.01
	-0.26 (-1.61)	-0.04 (-1.15)	-0.07 (-0.84)	-0.10 (-1.10)	-0.06 (-1.01)	0.00

Note:
** (**, ***) means that the appropriate parameter is different from zero at the 10% (5%, 1%) significance level, respectively.*

Table 5: Parameter estimates (z-statistics) for the US stock market in four-factor models, different time periods

	Time period	Alpha	r_{mt}-r_{it}	SMB_t	HML_t	WML_t	R^2
Portfolio 'sustainability leaders'	01/1998-04/2009	-0.16 (-0.69)	0.93*** (16.64)	-0.15* (-1.92)	-0.05 (-0.67)	-0.06 (-1.11)	0.79
	01/1998-08/2001	-0.10 (-0.17)	1.05*** (6.71)	-0.05 (-0.38)	0.06 (0.35)	-0.07 (-1.01)	0.68
	09/2001-08/2005	0.33 (0.96)	1.04*** (16.98)	-0.56*** (-4.63)	-0.38*** (-3.35)	0.11** (2.11)	0.87
	09/2005-04/2009	-0.21 (-0.76)	0.81*** (7.73)	-0.02 (-0.10)	0.10 (0.59)	-0.16* (-1.88)	0.90
Portfolio 'MSCI sustainability leaders'	01/1998-04/2009	-0.18 (-0.74)	0.96*** (16.77)	-0.18** (-2.34)	-0.02 (-0.29)	-0.05 (-0.91)	0.78
	01/1998-08/2001	-0.06 (-0.09)	1.07*** (6.41)	-0.06 (-0.56)	0.08 (0.45)	-0.07 (-1.00)	0.67
	09/2001-08/2005	0.34 (0.94)	1.08*** (16.21)	-0.64*** (-5.07)	-0.40*** (-3.67)	0.13** (2.11)	0.86
	09/2005-04/2009	-0.24 (-0.78)	0.85*** (7.55)	-0.07 (-0.27)	0.15 (0.92)	-0.14 (-1.67)	0.90
Portfolio 'other MSCI firms'	01/1998-04/2009	0.10** (2.01)	0.99*** (54.91)	-0.21*** (-8.81)	-0.02 (-1.48)	-0.01 (-0.57)	0.99
	01/1998-08/2001	0.36*** (3.89)	0.89*** (21.24)	-0.27*** (-15.20)	-0.13*** (-4.51)	-0.01 (-0.72)	0.99
	09/2001-08/2005	0.02 (0.40)	0.99*** (80.04)	-0.14*** (-4.52)	-0.03* (-1.73)	-0.01 (-1.12)	0.99
	09/2005-04/2009	-0.04 (-0.58)	1.00*** (41.50)	-0.11** (-2.47)	-0.01 (-0.28)	0.02** (2.11)	1.00
Long-short: MSCI firms	01/1998-04/2009	-0.28 (-1.09)	-0.03 (-0.42)	0.02 (0.29)	0.00 (0.03)	-0.05 (-0.79)	-0.02
	01/1998-08/2001	-0.42 (-0.65)	0.18 (1.02)	0.21* (1.99)	0.22 (1.13)	-0.06 (-0.93)	-0.01
	09/2001-08/2005	0.32 (0.81)	0.09 (1.30)	-0.50*** (-3.42)	-0.37*** (-3.07)	0.14** (2.25)	0.35
	09/2005-04/2009	-0.20 (-0.57)	-0.15 (-1.12)	0.04 (0.15)	0.16 (0.81)	-0.16* (-1.78)	0.11

Note:
** (**, ***) means that the appropriate parameter is different from zero at the 10% (5%, 1%) significance level, respectively.*

Table 6: Parameter estimates (z-statistics) for the European stock market in four-factor models, different time periods

	Time period	Alpha	r_{mt}-r_{it}	SMB_t	HML_t	WML_t	R^2
Portfolio 'sustainability leaders'	01/1998-04/2009	-0.11 (-0.36)	0.81*** (9.43)	-0.52*** (-3.59)	0.01 (0.06)	-0.20** (-2.31)	0.77
	01/1998-08/2001	-0.13 (-0.19)	0.48*** (6.84)	-0.79*** (-3.85)	-0.38** (-2.17)	-0.03 (-0.30)	0.64
	09/2001-08/2005	-0.15 (-0.30)	0.82*** (8.38)	-0.65*** (-5.19)	-0.03 (-0.13)	-0.10 (-0.62)	0.77
	09/2005-04/2009	0.30 (0.84)	0.94*** (12.81)	-0.40** (-2.34)	0.36 (1.00)	-0.36** (-2.48)	0.91
Portfolio 'MSCI sustainability leaders'	01/1998-04/2009	-0.04 (-0.13)	0.81*** (9.68)	-0.50*** (-3.40)	-0.05 (-0.38)	-0.17* (-1.93)	0.77
	01/1998-08/2001	0.10 (0.17)	0.50*** (8.00)	-0.70*** (-3.25)	-0.39*** (-2.85)	0.03 (0.28)	0.66
	09/2001-08/2005	-0.02 (-0.05)	0.78*** (8.07)	-0.69*** (-5.14)	-0.08 (-0.37)	-0.10 (-0.62)	0.76
	09/2005-04/2009	0.28 (0.80)	0.94*** (13.47)	-0.42** (-2.54)	0.25 (0.68)	-0.36** (-2.54)	0.91
Portfolio 'other MSCI firms'	01/1998-04/2009	0.23 (0.93)	0.85*** (13.14)	-0.44*** (-3.66)	0.05 (0.51)	-0.11* (-1.66)	0.84
	01/1998-08/2001	0.20 (0.45)	0.66*** (13.18)	-0.44** (-2.59)	-0.22** (-2.08)	-0.11 (-1.42)	0.83
	09/2001-08/2005	0.39 (0.89)	0.80*** (10.20)	-0.55*** (-3.82)	0.00 (0.01)	-0.03 (-0.26)	0.79
	09/2005-04/2009	0.46 (1.26)	0.99*** (10.26)	-0.65*** (-4.86)	0.31 (0.85)	-0.09 (-0.69)	0.92
Long-short: MSCI firms	01/1998-04/2009	-0.26 (-1.61)	-0.04 (-1.15)	-0.07 (-0.84)	-0.10 (-1.10)	-0.06 (-1.01)	0.00
	01/1998-08/2001	-0.10 (-0.27)	-0.16*** (-2.71)	-0.26** (-2.10)	-0.17 (-1.32)	0.14 (1.45)	0.05
	09/2001-08/2005	-0.41 (-1.46)	-0.03 (-0.39)	-0.14 (-0.92)	-0.08 (-0.62)	-0.08 (-0.95)	0.01
	09/2005-04/2009	-0.18 (-0.63)	-0.05 (-0.95)	0.23** (2.17)	-0.06 (-0.16)	-0.26** (-2.18)	0.12

Note:
** (**, ***) means that the appropriate parameter is different from zero at the 10% (5%, 1%) significance level, respectively.*

Table 7: Parameter estimates (z-statistics) for the US stock market in four-factor models, different time periods, no financial firms

	Time period	Alpha	r_{mt}-r_{it}	SMB_t	HML_t	WML_t	R^2
Portfolio 'sustainability leaders'	01/1998-04/2009	0.00 (0.00)	0.86*** (13.24)	-0.17* (-1.76)	-0.21*** (-2.98)	-0.05 (-0.92)	0.74
	01/1998-08/2001	0.09 (0.13)	0.92*** (4.72)	-0.03 (-0.22)	-0.08 (-0.38)	-0.09 (-1.36)	0.61
	09/2001-08/2005	0.33 (0.92)	1.14*** (19.95)	-0.61*** (-4.96)	-0.48*** (-4.49)	0.15* (1.86)	0.87
	09/2005-04/2009	-0.05 (-0.19)	0.79*** (8.22)	0.06 (0.30)	-0.19** (-2.11)	-0.06 (-0.68)	0.89
Portfolio 'MSCI sustainability leaders'	01/1998-04/2009	-0.02 (-0.07)	0.89*** (13.48)	-0.20** (-2.20)	-0.19** (-2.58)	-0.04 (-0.71)	0.73
	01/1998-08/2001	0.15 (0.22)	0.94*** (4.55)	-0.05 (-0.35)	-0.06 (-0.27)	-0.09 (-1.37)	0.60
	09/2001-08/2005	0.33 (0.89)	1.20*** (18.92)	-0.70*** (-5.32)	-0.51*** (-4.80)	0.17* (1.87)	0.85
	09/2005-04/2009	-0.07 (-0.25)	0.83*** (8.04)	0.03 (0.12)	-0.14 (-1.58)	-0.03 (-0.35)	0.89
Portfolio 'other MSCI firms'	01/1998-04/2009	0.18*** (2.83)	0.95*** (40.36)	-0.19*** (-6.84)	-0.16*** (-9.85)	-0.01 (-0.35)	0.97
	01/1998-08/2001	0.48*** (4.34)	0.81*** (21.11)	-0.23*** (-7.57)	-0.28*** (-8.56)	-0.03 (-1.68)	0.97
	09/2001-08/2005	0.04 (0.50)	0.98*** (43.06)	-0.17*** (-4.37)	-0.05 (-1.59)	-0.02 (-1.23)	0.98
	09/2005-04/2009	0.02 (0.27)	0.99*** (31.92)	-0.05 (-0.90)	-0.22*** (-4.35)	0.05*** (2.80)	0.99
Long-short: MSCI firms	01/1998-04/2009	-0.19 (-0.73)	-0.05 (-0.79)	-0.01 (-0.17)	-0.04 (-0.48)	-0.04 (-0.64)	-0.02
	01/1998-08/2001	-0.32 (-0.47)	0.13 (0.65)	0.18 (1.50)	0.22 (1.00)	-0.06 (-1.01)	-0.04
	09/2001-08/2005	0.29 (0.68)	0.22*** (3.23)	-0.53*** (-3.26)	-0.46*** (-3.70)	0.20** (2.07)	0.31
	09/2005-04/2009	-0.10 (-0.29)	-0.16 (-1.22)	0.08 (0.30)	0.08 (0.59)	-0.08 (-0.93)	0.03

Note:
** (**, ***) means that the appropriate parameter is different from zero at the 10% (5%, 1%) significance level, respectively.*

Table 8: Parameter estimates (z-statistics) for the European stock market in four-factor models, different time periods, no financial firms

	Time period	Alpha	r_{mt}-r_{it}	SMB_t	HML_t	WML_t	R^2
Portfolio 'sustainability leaders'	01/1998-04/2009	0.05 (0.16)	0.69*** (6.56)	-0.46*** (-2.74)	-0.34** (-2.50)	-0.10 (-1.00)	0.67
	01/1998-08/2001	-0.10 (-0.13)	0.33** (2.61)	-0.73*** (-3.15)	-0.75*** (-3.46)	0.02 (0.11)	0.54
	09/2001-08/2005	0.29 (0.61)	0.71*** (7.13)	-0.47*** (-3.43)	-0.62*** (-3.78)	0.04 (0.25)	0.69
	09/2005-04/2009	0.44 (1.34)	0.91*** (11.65)	-0.50*** (-2.85)	-0.09 (-0.25)	-0.17 (-1.24)	0.89
Portfolio 'MSCI sustainability leaders'	01/1998-04/2009	0.13 (0.44)	0.70*** (6.46)	-0.42** (-2.33)	-0.44*** (-3.62)	-0.06 (-0.55)	0.67
	01/1998-08/2001	0.10 (0.16)	0.35*** (2.92)	-0.58** (-2.42)	-0.79*** (-5.43)	0.15 (0.87)	0.56
	09/2001-08/2005	0.38 (0.81)	0.68*** (7.03)	-0.52*** (-3.82)	-0.68*** (-3.84)	0.04 (0.25)	0.67
	09/2005-04/2009	0.45 (1.38)	0.90*** (11.92)	-0.53*** (-3.02)	-0.11 (-0.30)	-0.16 (-1.22)	0.88
Portfolio 'other MSCI firms'	01/1998-04/2009	0.29 (1.17)	0.79*** (10.97)	-0.36*** (-2.76)	-0.07 (-0.83)	-0.07 (-0.90)	0.80
	01/1998-08/2001	0.24 (0.56)	0.61*** (7.66)	-0.33* (-1.84)	-0.32** (-2.68)	-0.10 (-0.93)	0.78
	09/2001-08/2005	0.43 (1.08)	0.77*** (10.55)	-0.45*** (-3.41)	-0.17 (-0.92)	0.02 (0.20)	0.78
	09/2005-04/2009	0.51 (1.21)	0.97*** (8.34)	-0.66*** (-4.21)	0.05 (0.10)	0.05 (0.37)	0.87
Long-short: MSCI firms	01/1998-04/2009	-0.16 (-0.90)	-0.08* (-1.82)	-0.06 (-0.63)	-0.37*** (-3.73)	0.01 (0.14)	0.08
	01/1998-08/2001	-0.14 (-0.34)	-0.26*** (-3.84)	-0.25* (-1.90)	-0.47*** (-3.93)	0.25 (1.66)	0.16
	09/2001-08/2005	-0.05 (-0.15)	-0.09 (-1.31)	-0.07 (-0.44)	-0.51*** (-2.99)	0.02 (0.26)	0.09
	09/2005-04/2009	-0.06 (-0.20)	-0.07 (-1.12)	0.13 (1.24)	-0.16 (-0.36)	-0.22* (-1.88)	0.06

Note:
** (**, ***) means that the appropriate parameter is different from zero at the 10% (5%, 1%) significance level, respectively.*